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Driverless Cars: Preparing for the Impact on the Automobile Insurance Industry

CAPSTONE REPORT

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Abstract

The purpose of this study is to investigate the problem of uncertain legal liability, and the related problem of declining profits, for automobile insurers pertaining to driverless cars. Resources published from 2012 to 2017 are presented to the chief executive officers of automobile insurers, the Highway Loss Data Institute division of IIHS, and the Casualty Actuarial and Statistical (C) Task Force of the NAIC for the purposes of planning for a future with driverless cars.

Keywords: driverless cars, insurance industry, profits, legal liability, planning, chief executive officer, highway, and task force

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Introduction to the Annotated Bibliography

Problem

Self-driving cars, or driverless cars, are in some degree of development by the automotive manufacturers and are projected to be a prevalent mode of transportation within the next decade (Shontell, 2016). For the purposes of this annotated bibliography, a driverless or autonomous car is defined as "[a] vehicle enabled with technology that has the capability of operating or driving the vehicle without the active control or monitoring of a natural person" (Schellekens, 2015, p. 507). Serious concerns about self-driving cars have also been raised, largely focusing on the impact these vehicles could have on three key issues: freedom, privacy, and liability (Boeglin, 2015).

While freedom and privacy concerns are raised for the drivers of the cars (Boeglin, 2015), liability concerns related to driverless cars exist for three different stakeholders: the driver, the insurer, and the manufacturer (Valerdi, 2017). Currently, the auto insurance industry determines liability based on the action of the driver, but the extent to which autonomous vehicles have control could impact the amount of negligence that can be attributed to a *driver*, especially if the *driver* is not necessarily in control of the vehicle at all (Anderson et al., 2014, pp.115-116).

In some scenarios, experts project that the manufacturers of driverless cars may be held liable for claims (Hevelke & Nida-Rumelin, 2015, p. 620). The idea behind holding manufacturers responsible for any crashes is rooted in the fact that the auto manufacturers would have designed the guidance system in the vehicle and, therefore, would also have the ability to recognize defects, and avoid releasing vehicles that are deemed defective (Hevelke & Nida-Rumelin, 2015, p. 620). There is an alternate perspective in which liability for an accident caused

by a defect is placed on the driver. A driver takes a risk when using an automobile, knowing that it may cause an accident, thus placing the driver and others at risk of being injured (Hevelke & Nida-Rumelin, 2015, p. 626). Responsibility between the manufacturer and the driver is still at question (Hevelke & Nida-Rumelin, 2015), and if an accident is caused by a defect in the car, the owner rather than the manufacturer may be held liable (Duffy & Hopkins, 2013, p. 106).

At the heart of the potential liability issues for auto insurers is concern about the impact on profitability, as a world with more driverless cars is expected to lead to fewer accidents, which could shrink the insurance market and reduce premiums (McDonald, 2013). According to the Insurance Information Institute (III), thousands of people die each year from car accidents, and over 40,000 people died from auto accidents in 2016 alone (2017). According to a 2015 U.S. Department of Transportation report, 94 percent of automobile accidents are believed to be caused by driver error, with 41 percent of those accidents being due to driver inattention. With driverless cars, however, these numbers will lessen because cars cannot get intoxicated, fatigued, or distracted (Preciado, 2014).

Insurers set prices based on the risks they insure, which impacts earnings (Baker & Swedloff, 2013, p. 1419). The automobile insurance industry uses contracts to aid in regulating the risk insurers take when insuring an individual and, as noted by Baker and Swedloff (2013) in the *UCLA Law Review*, "[i]nsurers use contract design to mitigate moral hazard in several ways. They use contract provisions like limits, deductibles, and coinsurance so that the insurance does not fully insulate people from their losses, keeping their skin in the game" (p. 1421). Baker and Swedloff (2013) also note that drivers are encouraged to be more vigilant through the design of the contracts. How to set the price of insurance for a driverless car based on risk, and

determining who the liable party might be in the case of an accident involving the driverless car, have not yet been resolved (Fletcher, 2015).

The National Association of Insurance Commissioners (NAIC; 2016) reported that the top 25 groups in the U.S. auto insurance industry earned over $578B in insurance premiums in 2015, but the envisioned widespread usage of autonomous cars is a threat to the industry and could reduce earned auto insurance premiums down to a $20B annual industry (Jiang, Petrovic, Ayyer, Tolani, & Husain, 2015, p. 17), a reduction of 97 percent. The threat is real. General Motors, Ford, Toyota, BMW, Mercedes, Volkswagen, Audi, Volvo, and Honda are all developing self-driving cars (Fournier, 2016). To avoid the threat posed by the advent of driverless cars, the insurance industry must act now (Brown, 2015). A decisive course of action is threatened, however, because insurance companies tend to estimate lower costs based on the analysis of real-world experiences and data, rather than guesses or intuition, and currently there are no data available on the actual risk posed by the driverless cars (White, 2014). Given the penchant for data-based decision making, the insurance industry may adapt too late by waiting for data generated by real-world experiences, rather than proactively seeking solutions beforehand (McDonald, 2013).

Purpose Statement

With manufacturers already beginning the development of autonomous vehicles, the amount of time available for adapting business models of dependent industries like automobile insurance to maintain or create profits is shrinking (Brown, 2015). The issue of legal liability is yet to be determined, and since the insurance industry generally prices based on risk, determining who is responsible directly impacts the profitability of each auto insurer (Baker & Swedloff, 2013).

The purpose of this annotated bibliography is to present literature that addresses the problem of uncertain legal liability with the advent of driverless cars and the related problem of declining profits for automobile insurers as driverless cars upend the industry.

Research Questions

Main question. As driverless cars become more common, how can insurers prepare for the legal liability concerns posed by driverless vehicles while remaining profitable?

Sub-questions. Who is liable in the event of a driverless car accident? Given that insurance premiums are partially based on risk (Baker & Swedloff, 2013, p. 1419), how do insurers determine premiums when the manufacturers may be partially responsible for an accident? How will laws and statutes evolve in the face of changing liability perspectives?

Audience

The audience for this annotated bibliography includes the chief executive officers (CEOs) of all automobile insurance companies, the Highway Loss Data Institute (HLDI) division of the Insurance Institute for Highway Safety (IIHS), and the Casualty Actuarial and Statistical (C) Task Force of the National Association of Insurance Commissioners (NAIC). A CEO has more power than anybody in the corporation and has the full responsibility of the company's well-being to consider (Porter, Lorsch, & Nohria, 2004). The CEO sets the overall strategy for an organization, and as such, the CEO must be aware of how the organization's markets are evolving with the latest technology and trends. Access to the information within this annotated bibliography can aid automobile insurance industry CEOs in evaluating the impact driverless cars will have on their industry and to begin strategizing methods for preparing their respective organizations for changes in liability.

The IIHS is an independent, nonprofit scientific and educational organization dedicated to reducing the losses caused by automobile accidents, and the HLDI division of the IIHS (2017) "shares and supports this mission through scientific studies of insurance data representing the human and economic losses resulting from the ownership and operation of different types of vehicles and by publishing insurance loss results by vehicle make and model" (p. 1). The IIHS is "…an independent, nonprofit scientific and educational organization dedicated to reducing the losses—deaths, injuries and property damage—from motor vehicle crashes" (IIHS & HLDI, 2017, p. 1). With this study analysts in the HLDI division of the IIHS can begin to study the impact driverless cars will have on injuries in the auto industry, and through this information, develop studies for the public to review regarding the safety of driverless cars. The application of the material presented in the annotated bibliography is useful to the HLDI and IIHS for the purposes of gathering statistics on driverless car accidents and providing safety tips and procedures for operating these vehicles.

The NAIC is "…the U.S. standard-setting and regulatory support organization created and governed by the chief insurance regulators from the 50 states, the District of Columbia, and five U.S. territories. Through the NAIC, state insurance regulators establish standards and best practices, conduct peer review, and coordinate their regulatory oversight" (p. 1). The Casualty Actuarial and Statistical (C) Task Force of the NAIC has the primary purpose of providing reserving, pricing, ratemaking, statistical, and other actuarial support to NAIC. This group also oversees the committees, task forces, and/or working groups; monitors national casualty actuarial developments and considers regulatory implications to facilitate discussion among regulators regarding rate filing issues of common interest across states (NAIC Casualty Actuarial and Statistical (C) Task Force, 2017). Specifically, this group may use this study to begin crafting

regulations for driverless cars and creating the landscape that the insurance industry will operate within.

Search Report

Search strategy. The search strategy deployed for this annotated bibliography involved accessing the University of Oregon (UO) Libraries' databases and performing keyword searches. The search results were initially assessed for timeliness and relevance to the subject of driverless cars. The UO Libraries were selected in an effort to gain scholarly, unbiased references for this annotated bibliography.

Driverless car technology is a relatively new phenomenon, so a minimal amount of peer-reviewed research on the topics of legal liability and profitability in the insurance industry related to the topic exists. To find timely and relevant articles for this emerging technology, only articles/journals from 2012 through 2017 were considered for inclusion in this annotated bibliography, but some key definitions were taken from articles published prior to 2012. Although some articles provided relevant information, locating scholarly and peer-reviewed articles, rather than biased sources, on driverless technology proved difficult.

Search engines and databases. The University of Oregon Libraries' databases were the main tool used to search for literature. Google Scholar was used to search for literature, but most of the search results from Google Scholar were not useful. In order to provide a direct link to the articles outside of the UO Libraries' databases, Google searches were utilized to find these links. When a Google search did not yield a link, or there was no doi available, the link to the UO database was provided. Below is a list of the search engines and databases utilized to locate material for this annotated bibliography:

- UO OneSearch,

- UO Libraries LibrarySearch,
- Academic OneFile,
- EBSCO Host,
- JSTOR,
- Academic Search Premier, and
- Google Scholar.

Key terms. The list below includes the key terms that were used to locate relevant articles for this annotated bibliography:

- Driverless cars,
- Insurance industry,
- Profitability,
- Injury,
- Legal liability,
- Laws,
- Torts,
- Autonomous,
- Property damage,
- Vehicle,
- Technology,
- Products,
- Information management,
- Ownership,
- Data,

- Self-driving,
- Cars,
- Responsibility,
- Jobs,
- Risk, and
- Innovation.

Documentation approach. Each reference was logged into an Apple Pages document and organized into the categories of background of driverless cars, legal liability, and impact on profitability. Each reference included a link to the material, a description of the key words used, and the databases accessed. The Apple Pages document was converted into a Microsoft Word document for all viewers to access. The Apple Pages file is saved locally.

Reference evaluation criteria. Each reference source in this annotated bibliography was evaluated and chosen based on the authority of the author; timeliness of the work; quality in regard to grammar, punctuation, spelling, and information; relevance to the problem explored; and lack of bias, as outlined by the Center for Public Issues Education's *Evaluating Information Sources* document (n.d.). There are sources in the reference list of this annotated bibliography that are not annotated, but were used to define the context or terms that are shared or similar in nature across the annotated sources.

A source was considered authoritative if it was written by an individual, or team of people, who hold professional titles in the field of study, have advanced degrees in an area related to business or information technology, and work in a field related to their areas of study. A source was considered unbiased if it was published in a journal, or as a case study, where no product or service was being sold as the primary reason for conducting the study. Also, if a

source was from an industry white paper, it was selected based on its informative value, and not based on making a sale or coercing a reader into any financial obligation. Due to the relatively new phenomena of driverless car technology, sources were limited to the past five years, from 2012 through 2017, to assure timely and recent information. Sources were determined to be quality sources if they evidenced proper grammar, punctuation, spelling, and overall clarity of information. To point the audience to sources that could aid in future policy making or business decisions, sources were deemed relevant based on breadth of information, access to further sources, and whether the source was from either a scholarly or unbiased business publication that was written specifically for the purpose of exploring legal liability and insurance industry profitability pertaining to driverless cars.

Annotated Bibliography

This annotated bibliography includes reference material published between 2012 and 2017 for the purpose of providing recent and relevant material to the discussion of autonomous vehicles and their projected impact on the automobile insurance industry. The ideas and information shared in each abstract below should not be construed as original content from the author of this annotated bibliography, but as material presented by the respective author(s) of each source. The author of this paper prepared the summaries.

Category 1: A Background on Driverless Cars

Anderson, J. M., Kalra, N., Stanley, K. D., Sorensen, P., Samaras, C., & Oluwatola, O. A. (2014). *Autonomous vehicle technology: A guide for policymakers*. Santa Monica, CA: RAND. Retrieved from http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-2/RAND_RR443-2.pdf

Abstract. The automotive industry appears close to substantial change engendered by "self-driving" technologies. This technology offers the possibility of significant benefits to social welfare—saving lives; reducing crashes, congestion, fuel consumption, and pollution; increasing mobility for the disabled; and ultimately improving land use. This report is intended as a guide for state and federal policymakers on the many issues that this technology raises.

Summary. This source is relevant for this study because it provides a background on the driverless car industry, which helps set the baseline of where the industry was as of the date of publication in 2014, while also exploring the current state of autonomous technology and associated legal liability. The authors provide a description for the five current levels of autonomous vehicles:

- Level 0: The human driver is in complete control of the vehicle.
- Level 1: One function is automated.
- Level 2: More than one function is automated, but the driver must remain attentive.
- Level 3: Driving functions are sufficiently automated and the driver can engage in other activities.
- Level 4: The car can drive itself without a human driver.

Beyond a background of the industry, this source also provides details behind regulating driverless cars and what the liability implications are pertaining to drivers, insurers, and manufacturers. It is noted Google has logged more than 500,000 miles of autonomous driving on public roads without incurring a crash attributable to the technology. To achieve safe autonomous driving, the vehicles deploy a "sense-plan-act" design that gathers raw data from the outside world, which provides the vehicle with information about the environment in which it is driving. The "sense-plan-act' design is not 100% effective to date, as challenges facing driverless cars such as foggy weather conditions that may disrupt vehicle sensors and degrading sensors that could lead to electrical failures could place the vehicle and driver at risk of injury.

With respect to liability, this source reminds the audience of the three theories of driver liability at the time of publication: traditional negligence, no-fault liability, and strict liability. The authors posit that autonomous vehicles will reduce the incidence of crashes, thus reducing automobile insurance costs. As a result, the paradigm for liability in regard to drivers, insurers, and manufacturers is set to shift. For drivers, responsibility will shift from the driver to the technologies of the car itself, thus making it more difficult for someone to successfully sue an individual for damages.

This source ties the lessening of liability on the drivers to a reduced need for automobile insurance, as the need to insure drivers for their potential risk is significantly reduced. Currently, manufacturers are subject to product liability suits, which are more expensive to bring and take more time to resolve, but there is opposition to manufacturers being free from negligence under product liability laws. The authors conclude that manufacturer liability is expected to increase, while the decrease in number of crashes will lead to lower insurance costs, affecting the entire industry.

Fournier, T. (2016, June). Will my next car be a libertarian or a utilitarian? Who will decide?

IEEE Technology & Society Magazine, 35(2), 40-45. doi:10.1109/MTS.2016.2554441

Abstract. Change is coming. Experimental, self-driving cars are plying public roads in many U.S. states, heralding what some automotive industry experts and regulators see as a profound and imminent disruption in the transportation industry, and a change to our way of life. With this change, a large swath of human choices regarding operation of vehicles, response to driving hazards, and compliance with important as well as petty laws will be consigned to computer software. Many of these choices are ethical in nature, and their expression in machine-controlled software will encode answers to important questions about liberty and utility - questions that remain a matter of serious social contention. Who will decide how these choices are encoded in software, and will their digital mandates be guided by respect for individual liberty or deference to social utility?

Summary. This source is relevant for this study because it provides context and background for the current state of driverless vehicles pertaining to the adoption of the technology and legal liability. The author of this article mentioned that six states have currently enacted laws permitting regulated use of autonomous vehicles, while sixteen other states have

drafted legislation on the matter as of 2015. The current mood in the industry is that it is only a matter of time before self-driving vehicles surpass human-operated cars in terms of safety and efficiency. The reason autonomous vehicles are being developed is partially due to the number of vehicle deaths in the U.S. each year and the fact that drivers are the critical reason for 94% of all crashes. The idea of driverless cars is to reduce the number of accidents on the road, but the development of driverless cars will require manufacturers to shoulder most of the legal liability in regard to accidents, since preprogrammed decision-making software would be installed in each car. The author concludes that there are many factors to be considered when thinking about liability from the perspective of manufacturer versus driver, such as the vehicle's ability to weigh decisions where there may be no escaping an accident and adjusting accordingly, and the loss of situational control from the human perspective.

Swanson, A. R. (2014, Summer). "Somebody grab the wheel!": State autonomous vehicle legislation and the road to a national regime. *Marquette Law Review, 97*(4), 1085-1147. Retrieved from http://scholarship.law.marquette.edu/mulr/vol97/iss4/8/

Abstract. This comment critically analyzes bills, statutes, and regulations that govern the use of autonomous vehicles. Autonomous vehicles, also known as self-driving cars, represent the future of personal transportation. States have begun to regulate the testing and implementation of this technology onto public highways, and the federal government has suggested baseline regulations for states to consider when proposing future legislation. First, this Comment provides a brief overview of autonomous vehicle technology, as well as the pros and cons of a self-driving vehicle. Second, this comment analyzes both enacted and proposed legislation at the state level. This comment then recommends various provisions that states should implement in future legislation and cautions against the inclusion of various provisions that will impede the

implementation of autonomous vehicle technology. This comment also offers a brief look at the possible effect that international agreements may have on the commercial availability of autonomous vehicles. Finally, this comment argues that the National Highway Transportation Safety Administration should exercise its regulatory authority to provide a national regulatory regime regarding autonomous vehicles.

Summary. This source is relevant for this study because it provides background on driverless cars by focusing on the proposed regulation of the industry, and further provides background into the impact such regulation would have on the relationship between driver and vehicle in the name of reducing traffic accidents. The author of this study posits that driverless cars are being developed in certain ordered steps, starting with vehicles that allow the driver to intervene and override the vehicle in decision-making areas, leading up to fully autonomous vehicles that do not require a driver in the vehicle at any point. Proposed regulations on driverless vehicles suggest that drivers should have the ability to take control of the driverless vehicles, but this would place some responsibility on the operator in the event of a crash. However, the author posits that the ideals of the National Highway Traffic Safety Administration (NHTSA), which has the goal of reducing traffic accidents, will be fulfilled by regulating the inclusion of a driver override option into each driverless vehicle. The author introduces the idea of mandatory warnings of potential technology failure in all driverless vehicles, which will lead to the safe operation of a driverless vehicle. The author concludes that regulating driver override systems to prevent accidents will smooth the advance of driverless cars and allow for a quicker transition to usage.

Category 2: Driverless Cars and Liability: Preparing for a New Paradigm

Boeglin, J. (2015). The costs of self-driving cars: Reconciling freedom and privacy with tort liability in autonomous vehicle regulation. *Yale Journal of Law & Technology, 17*(1), 171-203. Retrieved from http://digitalcommons.law.yale.edu/cgi/viewcontent.cgi?article=1112&context=yjolt

Abstract. Nearly all of the literature on self-driving cars explores either their impact on social values, like freedom and privacy, or the questions they pose for legal liability. These lines of inquiry have developed largely in isolation, with little effort to examine how they might intersect and inform each other. This article advances an integrated approach: regulators should consider freedom, privacy, and liability as interlocking pieces—not independent elements—of the puzzle of self-driving car regulation. Explorations into the laws of agency and product liability demonstrate that an actor's post-sale control of and access to an autonomous vehicle may determine that actor's liability for its accidents. As a result, the more that users want to preserve their freedom and privacy, the more liability they may end up retaining for the behavior of their self-driving cars. This article then provides the first sustained inquiry into how different liability regimes for autonomous vehicles might generate sizable efficiencies in liability and insurance administration. The article closes by making a normative appeal to regulators: only allow autonomous vehicles to infringe on user freedom and privacy to the extent that (1) reductions in freedom and privacy lead to equivalent reductions in liability for the users of self-driving cars; and (2) the social costs incurred by forfeiting these values will be outweighed by administrative efficiencies or other identifiable social benefits. By tying the reduction of user freedom and privacy to improvements in both individual and social welfare, this article charts a

possible course for regulators to reconcile freedom and privacy with tort liability in autonomous vehicle regulation.

Summary. This source is relevant for this study because it examines the shifting ideals of legal liability pertaining to driverless cars. The author posits that there are currently five parties likely to be held liable for an accident caused by a self-driving car: the user, the owner, the car manufacturer, the manufacturer of the autonomous components, or a government entity. This article focuses on the liability of the user, auto manufacturer, and government entities.

The author posits that autonomous vehicles liability should be based on the law of agency, rather than product liability, since product liability suits are often expensive and could be a bad fit for the frequent litigation that car accidents attract. However, if obvious software malfunctions caused the loss to occur, the author asserts that the manufacturer should be held to a standard of liability, thus not completely forfeiting the idea of product liability laws applying in these cases. The author raises the point that determining liability for crashes involving autonomous vehicles would be cheaper than crashes involving vehicles operated by drivers, since 360-degree footage of the autonomous vehicle's surroundings could more precisely describe what happened in the collision, rather than relying on human recollection. Also, the private insurance industry could use the information in the autonomous vehicles to decrease generalizations, and rely less on demographics such as gender, age, marital status, or zip code to set the price for insurance, and instead use driving behaviors in the varying autonomy levels of driverless cars as the determining factor in premium pricing. The author concludes that there are still a lot of issues that must be addressed pertaining to driverless cars and liability, as driverless cars have the potential to radically alter the U.S. roadway system.

Duffy, S., & Hopkins, J. P. (2013). Sit, stay, drive: The future of autonomous car liability. *SMU Science & Technology Law Review, 16*, 101-123. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2379697

Abstract. Driverless cars have made the jump from fantasy to the physical realm. Technology has evolved to the point where autonomous cars will be a common sight in the very near future. The benefits of autonomous cars are plentiful: increased safety for car passengers, who no longer have to fear drunk, reckless, or distracted drivers, increased productivity for passengers who can use the travel time to accomplish tasks, decreased reliance on fuel as the cars often incorporate solar panels and automatically adjust speed to maximize fuel efficiency, and decreased traffic congestion as the cars can identify upcoming trouble spots and take alternate routes to avoid delay. However, this innovative technology brings with it an unaddressed legal issue: how will legal liability be assessed when these cars collide with other cars, pedestrians, or property? Current law surrounding liability for automobile accidents largely bases liability on the actions of the driver. Similarly, looking to the liability law governing computers does not address the issue either, as the laws base liability on the actions of the operator of the computer system, and the scant laws related to autonomous computer systems apply only to commercial transactions. This article proposes that the solution to this legal issue lies in treating autonomous cars like man's best friend, the dog. Dogs and computers are both treated as chattel under tort law, and are similar in that they can act independently, yet are considered property of another. The laws governing canine ownership show that applying strict liability to autonomous car owners accomplishes the dual purpose of fairly assessing liability without hampering the widespread adoption of this marvelous technology.

Summary. This source is relevant for this study because it examines the liability challenges facing insurance companies, lawmakers, and police, namely the challenges that arise because attributing liability in an automobile accident assumes that the driver is human, and there is no current body of law that addresses liability for autonomous cars. Autonomous cars pose a risk to the general public because glitches, viruses, network failures, and programming errors that afflict computerized devices can also occur in driverless cars. This article provides the example of Toyota, which recently settled a class action lawsuit for car accidents caused by the sudden malfunction of autonomous acceleration systems.

Currently, there are three situations for assessing automobile liability: driver error, runaway cars, and defective vehicles. There are some jurisdictions that operate under strict liability laws, which were enacted to hold the owner of the vehicle accountable for the safe use of the vehicle. The author posits that strict liability laws in place for the owners of canines may be the best applicable theory of law for autonomous cars because the laws would allow the owner of the vehicle to be found responsible without determining the cause of the accident, similar to findings of liability with injuries caused by dogs.

The reason offered for using strict liability in autonomous vehicle accident cases is for litigation to be quick and efficient, while allowing law to become more predictable in this arena. The role of insurance for autonomous vehicles would be similar to the role played now by auto or canine insurance: to help defray financial risks that may arise from an autonomous vehicle accident. The authors posit that risks associated with drunk driving, road rage, and reckless or negligent driving would eventually be eliminated from insurance premiums, thus lowering the risk of insurance companies, which leads to lower insurance costs and lower insurance premiums for autonomous vehicle owners. The authors concluded that strict liability laws are applicable to

the usage of autonomous vehicles to incentivize manufacturers to push the adoption of driverless technology.

Eastman, A. D. (2016). Is no-fault auto insurance the answer to liability concerns of autonomous vehicles? *American Journal of Business and Management, 5*(3), 85-90. doi:10.11634/216796061605816

Abstract. Automotive travel will change dramatically as technological advances shift more driver functions to computers, cameras, and sensors. Ultimately, drivers will become a thing of the past and all Americans will become passengers in fully self-driving vehicles. Automobile ownership may decline as ride-sharing services utilizing autonomous vehicles proliferate. Fundamental changes in how Americans get from one location to another necessitate a change in how liability is assessed and damages are paid in the event of automobile accidents. No longer will human error (driver negligence) be the cause of most automobile accidents. Complexities and costs involved with determining who should be responsible for damages may cause regulators, insurance companies, and consumers to reconsider the benefits of no-fault automobile insurance. Revised no-fault automobile insurance can provide fair compensation while keeping uncertainty about liability from deterring the advancement and implementation of autonomous vehicle technologies.

Summary. This source is relevant for this study because it examines the need to determine the legal liability of autonomous vehicles as 90 percent of current automobile accidents are caused by human error. When addressing the question of who is the liable party in an autonomous vehicle accident, the author mentions that legal scholars suggest that assessing responsibility should be focused on the level of reliance the driver has on the autonomous vehicle because there is a difference between a fully autonomous vehicle and a vehicle where the

driver executes some level of control. Determining liability from a product standpoint could become difficult, as there could be multiple manufacturers that played a role in the development and construction of an autonomous vehicle. In addition, some attorneys suggest that examining the ethical guidelines that were programmed into the vehicles software could even play a role in this issue. The author of this work also details how a national, federally mandated claims fund to compensate injured parties from autonomous vehicle accidents may be wise as to prevent the development of these vehicles from being stifled, and could be funded through an excise tax on human vaccines.

The author reviews other avenues of liability law and also posits that a revised no-fault system run by private insurance companies could provide benefits as private insurance companies are equipped to assess risk and determine premium levels. The author concludes that autonomous vehicle technology is advancing, and with the safety features these vehicles provide, there is a need for liability reform, especially as varying levels of autonomous vehicles integrate onto a road where vehicles with drivers still exist.

Greenblatt, N. A. (2016, February). Self-driving cars and the law. *IEEE Spectrum, 53*(2), 46-51. doi:10.1109/MSPEC.2016.7419800

Abstract. It is the year 2023, and for the first time, a self-driving car navigating city streets strikes and kills a pedestrian. A lawsuit is sure to follow. But exactly what laws will apply? Nobody knows. Today, the law is scrambling to keep up with the technology, which is moving forward at a breakneck pace, thanks to efforts by Apple, Audi, BMW, Ford, General Motors, Google, Honda, Mercedes, Nissan, Nvidia, Tesla, Toyota, and Volkswagen. Google's prototype self-driving cars, with test drivers always ready to take control, are already on city

streets in Mountain View, Calif., and Austin, Texas. In the second half of 2015, Tesla Motors began allowing owners (not just test drivers) to switch on its Autopilot mode.

Summary. This source is relevant for this study because it explores how the development of self-driving cars is outpacing current laws. Although laws will evolve to include driverless vehicles, and the matter of manufacturer liability will become more pressing, there is no strictly applicable case law on which to base any decisions at this time. Currently, states such as California and Nevada allow self-driving cars so long as there is a driver behind the wheel, while other states allow only testing on designated roads. As it stands, scholars believe that an accident will lead to a major design defect lawsuit, which worries the auto manufacturing industry.

This article speaks directly to the issue of legal liability, and the author concludes that manufacturers of driverless vehicles should only be held liable to the degree that a human would be held liable for the same level of negligence. Auto insurers could weigh in on the legal liability question based on their collective years of assigning negligence to drivers, and provide cheaper insurance due to the assumption that driverless cars will provide more safety. This article is important to the audience because, while there is a lot left to be decided pertaining to laws and legal liability, driverless car technology is forging ahead, which is challenging lawmakers to keep up.

Gurney, J. K. (2013, November, 15). Sue my car not me: Products liability and accidents involving autonomous vehicles. *University of Illinois Journal of Law, Technology & Policy, 2013*(2), 247-277. Retrieved from https://works.bepress.com/jeffrey_gurney/1/

Abstract. Autonomous vehicles will revolutionize society in the near future. Computers, however, are not perfect, and accidents will occur while the vehicle is in autonomous mode. This article answers the question of who should be liable when an accident is caused in autonomous

mode. This article addresses the liability of autonomous vehicle by examining products liability through the use of four scenarios: the Distracted Driver; the Diminished Capabilities Driver; the Disabled Driver; and the Attentive Driver. Based on those scenarios, this article suggests that the autonomous technology manufacturer should be liable for accidents caused in autonomous mode because the autonomous vehicle probably caused the accident. Liability should shift back to the "driver" depending on the nature of the driver and the ability of that person to prevent the accident. Thus, this article argues that an autonomous vehicle manufacturer should be liable for accidents caused in autonomous mode for the Disabled Driver and partially for the Diminished Capabilities Driver and the Distracted Driver. This article argues the Attentive Driver should be liable for most accidents caused in autonomous vehicle. Currently, products liability does not currently allocate the financial responsibility of an accident to the party that is responsible the accident, and this article suggests that courts and legislatures need to address tort liability for accidents caused in autonomous mode to ensure that the responsible party bears responsibility for accidents.

Summary. This source is relevant for this study because it reviews legal liability from the perspective of four scenarios in which drivers could be categorized: distracted drivers (purposely engage in actions rather than driving), diminished capabilities drivers (drivers that may not be capable of driving a vehicle otherwise, such as an intoxicated person, a minor, or the elderly), disabled drivers (drivers who rely completely on autonomous vehicles since they are physically incapable of operating a vehicle), and attentive drivers (drivers who may not trust the autonomous vehicle, so maintains the same attention they would as if they were driving the vehicle).

The author posits that there are three common grounds for product liability suits: manufacturing defect, design defect, and warning defect. However, the author notes that there are defenses that manufacturers could raise in a product liability suit, such as comparative negligence (the manufacturer is not totally to blame, and the driver should have the ability to prevent the accident), misuse (where the driver used the vehicle in an unforeseeable manner other than the manufacturer intended, such as through making vehicle modifications), state of the art (although the manufacturer is aware of the issues, technology or science may not be advanced enough to avoid protect against all perils), and assumption of risk (the drivers would realize the risks they are taking getting into driverless cars, thus holding some degree of responsibility in the event of a loss). This article notes that not all defenses may be applicable to every driver based on the categories presented. The author concludes that while current liability law will not be able to assess fault in accidents involving driverless vehicles, driverless cars will be on the market within the decade, which will lead to inevitable disputes over malfunction. This article is important to the audience because shifting liability laws will provide opportunities and obstacles to each insurer when assessing liability.

Herd, A. (2013, Fall). R2DFORD: Autonomous vehicles and the legal implications of varying liability structures. *Faulkner Law Review, 5*(1), 29-58. Retrieved from https://works.bepress.com/alexander_herd/1/

Abstract. The World Health Organization estimates that by 2030 traffic accidents will be the fifth leading cause of death in the world. Thus, when Google announced that it had designed an autonomous car that could reduce traffic accidents by as much as ninety percent, there was cause for excitement. Some states have already enacted legislation to permit the use of autonomous cars in anticipation of their release later this decade. As a result, courts and

lawmakers need to consider who will be liable when the car that drives itself crashes. Standards used in aviation and naval cases regarding autopilot can be applied to the more advanced technology behind autonomous cars using the pilot-in-command regulations. Product liability standards, such as the "consumer expectations" and "risk utility" tests, may also provide guidance. The complex nature of the autonomous system and the differences between a pilot using auto-pilot and a driver allowing the car to drive itself make the "pilot-in-command" and "consumer expectations" standards less than ideal. This comment argues that the flexibility and balance from the risk-utility test is the most suitable fit for the autonomous car.

Summary. This source is relevant for this study because it examines legal liability pertaining to driverless cars, namely through the exploration of the similarities between auto-pilot systems in aircraft or naval vessels and the autonomous features in driverless cars. The author posits that existing product liability standards, such as consumer expectations or the risk-utility tests, can be applied to driverless cars while also proposing that aviation or naval standards may help in easily assigning liability to a responsible party in an autonomous vehicle accident.

Before liability laws can be adapted to driverless cars, or even purchased by consumers, the operation of a driverless car must first be considered legal. As of the publication date of this study, the Geneva Convention, to which the U.S. is a party and which helps regulate traffic safety, states that a driver must always be able to control the vehicle. Also, the NHTSA mandates that vehicles must possess a driver in order to notify other drivers of a hazard. The author provides an example at the state level of a New York code that mandates a driver to always have at least one hand on the steering wheel.

The author examines two common tests for a court to determine if a product is defective: the consumer expectations test and the risk-utility test. The consumer expectations test is designed to examine whether danger stems from the design of the product and operates under the premise that an ordinary consumer may not have been able to reasonably foresee an issue. The risk-utility test comes from the Restatement of Torts, which mentions that harm caused by a product could be reduced or avoided by a reasonable alternative design.

The author points out that aviation law could be useful in determining liability of autonomous vehicles. Currently, FAA regulations require the pilot to be responsible for the safe operation of an aircraft. The author posits that, although auto-pilot features are available in aircraft, they are only seen as a guide and not a substitute for controlling the aircraft. The author also mentioned that there are cases in which auto-pilot system malfunctions have been deemed to be due to human error of the operator, such as in *Beverly Richardson v. Bombardier*. Similarly held beliefs are also applied to the operation of watercraft, such as the case of *Boucvalt v. Sea-Trac Offshore Servs.*, which also found humans to be responsible during a time when auto-pilot was in use. The author does note that auto-pilot capabilities in air and watercraft differ from autonomous vehicles: air and watercraft typically utilize auto-pilot in the middle of their journey and their auto-pilot systems do not adapt to changing environments like the systems in driverless vehicles do.

The author concludes that while applying aviation and naval standards to driverless cars would be the easiest method of determining liability because drivers would still receive the blame in an accident, the risk-utility test is the best option as it ensures the focus for the courts is on the design of the car and maintains the interests of both the driver and the manufacturer.

Hevelke, A., & Nida-Rumelin, J. (2015, June). Responsibility for crashes of autonomous vehicles: An ethical analysis. *Science and Engineering Ethics, 21*(3), 619-630. doi:10.1007/s11948-014-9565-5

Abstract. A number of companies including Google and BMW are currently working on the development of autonomous cars. But if fully autonomous cars are going to drive on our roads, it must be decided who is to be held responsible in case of accidents. This involves not only legal questions, but also moral ones. The first question discussed is whether we should try to design the tort liability for car manufacturers in a way that will help along the development and improvement of autonomous vehicles. In particular, Patrick Lin's concern that any security gain derived from the introduction of autonomous cars would constitute a trade-off in human lives will be addressed. The second question is whether it would be morally permissible to impose liability on the user based on a duty to pay attention to the road and traffic and to intervene when necessary to avoid accidents. Doubts about the moral legitimacy of such a scheme are based on the notion that it is a form of defamation if a person is held to blame for causing the death of another by his inattention if he never had a real chance to intervene. Therefore, the legitimacy of such an approach would depend on the user having an actual chance to do so. The last option discussed in this paper is a system in which a person using an autonomous vehicle has no duty (and possibly no way) of interfering, but is still held (financially, not criminally) responsible for possible accidents. Two ways of doing so are discussed, but only one is judged morally feasible.

Summary. This source is relevant for this study because it examines driverless vehicle liability through the lenses of the manufacturers, the operators of driverless vehicles as a form of strict liability, and through the duty to intervene. The authors posit that holding the manufacturer

responsible for driverless vehicle crashes would be an obvious choice, but would prohibit the manufacturers from further developing autonomous vehicles due to the risk of being found liable for accidents. An alternative provided by the authors is that users of driverless cars would need to pay attention to their surroundings and have the duty to intervene to avoid accidents, or be found liable for accidents when this duty is not fulfilled. The authors also posit that as long as there is a duty for driverless car operators to intervene in order to prevent an accident, the driver has a moral obligation to do so. However, as driverless technology reaches the level of automation where operation of the vehicle is safer than having a driver behind the wheel, the duty and/or ability to intervene diminishes, since users would need to pay less attention to the vehicle versus a car with no or limited autonomous features.

The issue of defamation is also examined, as blaming a person for not stopping an accident in a fully autonomous vehicle could be cause for defamation since the occupant may not have had the duty to do so. Another option put forth by the author is to consider the person in charge of the autonomous vehicle as morally responsible for the accident as a form of strict liability, even if they have no duty or ability to intervene in preventing an accident. The authors base this rationale on the assumed risk a person has when operating a motor vehicle, autonomous or not.

The authors conclude that the duty to intervene, and placing responsibility on the driver rather than solely on the manufacturer, are viable options in assigning liability to the operators of driverless cars. The authors' rationale is based on the fact that, just as drivers assume the risk of operating a non-driverless vehicle today, the occupant of a driverless vehicle takes that same risk when entering a sophisticated, driverless car.

Preciado, M. A. (2014). The need for a statute of repose in autonomous vehicle liability. *Products Liability, 25*(2), 12-13. Retrieved from http://web.a.ebscohost.com.libproxy.uoregon.edu/ehost/detail/detail?sid=bc48ccfd-76e5-4d86-94b2-e1f0a72fbbde%40sessionmgr4006&vid=4&hid=4204&bdata=JnNpdGU9ZWhvc3QtbGl2ZSZzY29wZT1zaXRl#AN=110468066&db=aph

Abstract. The article discusses the importance of enacting a statute of repose for the autonomous vehicle industry. It is critical on the possible occurrence of traffic accidents due to the failure of automobile owners to install software updates for these vehicles. It says that the statute of repose will provide greater certainty to manufacturers since it is triggered by an event or a completion of an action.

Summary. This source is relevant for this study because it examines legal liability pertaining to driverless cars through the issue of software updates. The author posits that, just as Apple pushes software updates to iPhones, the same approach will be taken with driverless cars, but the user will be responsible for accepting the updates and letting them download. The issue with failing to accept an update to a driverless car could be the difference in whether or not a global positioning system (GPS) system fails, and could cause a fatal accident. If someone does not update a vehicle for years, then has an accident and sues the manufacturer for a defective product, the author poses the question of who is liable.

In response to this question, the author posits that individual states should enact statutes of repose for autonomous vehicle liability. The difference between a statute of repose and a statute of limitations (which dictates how long someone can file a claim after an accident occurs), is that a statute of repose is based on the completion of an act and sets a timeframe

during which an action could be brought against the manufacturer. The author shares an example in which a statute of repose is in place that bars suits against manufacturers; in the example, a statute of five years is allowed by law after an update is issued. If five years pass, and the driverless car is involved in an accident that could have been avoided through the software update, then the owner cannot bring suit against the manufacturer for a defective product.

The author concludes that, although a statute of repose seems to favor the manufacturers, it also benefits all of society. The rationale provided by the author is that this will create incentives for driverless car owners to keep their vehicles updated while preventing software-related accidents.

Rapaczynski, A. (2016, April 14). Driverless cars and the much delayed tort law revolution. (Columbia Law and Economics Working Paper No, 540). Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2764686

Abstract. The most striking development in the American tort law of the last century was the quick rise and fall of strict manufacturers' liability for the huge social losses associated with the use of industrial products. The most important factor in this process has been the inability of the courts and academic commentators to develop a workable theory of design defects, resulting in a wholesale return of negligence as the basis of products liability jurisprudence. This article explains the reasons for this failure and argues that the development of digital technology, and the advent of self-driving cars in particular, is likely to force a comprehensive rethinking of products liability, a large-scale return to the principle of strict manufacturers' responsibility, and a host of other developments of lasting historical and economic significance. The article argues that an integration of manufacturing and insurance industries may be one of these developments.

Summary. This source is relevant for this study because it examines how the advent of driverless cars is raising concerns regarding liability law, and how a return to strict manufacturer liability may occur. The author begins by exploring the history of strict product liability, noting that since manufacturers have the best access to information regarding the safety of their products, they have the capability to resolve any safety problems. The author also explores how moving toward strict liability laws would essentially make manufacturers into the insurers of their own products, but notes the cost of this insurance would be passed along to consumers, thus making products more expensive because of the inclusion of mandatory insurance.

The author puts forth the idea that even if current methods of determining fault applied to driverless cars (such as finding the driver responsible for the vehicle's actions), not all accident costs are borne by the consumers. If a driver can prove that a defective vehicle was a factor in the accident, at least in some part, then the manufacturer of that vehicle will bear some financial responsibility. Based on this line of reasoning, the author posits that as drivers become less and less of a factor in operating vehicles themselves, that manufacturers will become increasingly responsible for most, if not all, of the responsibility for a driverless car accident. The author advises that there were legislative interventions being reviewed as of the date of publication to limit manufacturer responsibility to prevent a slowdown in the introduction of driverless vehicles.

The author also explores how the role of automobile insurance will be affected by the advent of driverless vehicles. While driverless cars are integrating into society, current liability laws will remain applicable since driverless cars will be operating amongst vehicles that require a driver, thus maintaining the need for independent insurers. The author posits that even when driverless cars gain prevalence in society, a driver's negligence may never be totally eliminated.

Another theory posed by the author is that individuals can negotiate with the manufacturer in advance the responsibility for certain types of accidents involving driverless cars. For example, when a purchaser of a driverless vehicle wishes to add an option that will allow the driver to take control of the vehicle, such as when using the vehicle in an off-road manner, the owner may agree to release the manufacturer of liability while the vehicle is in the control of the driver. The author concludes that it will take time to see the impact that driverless technology has on product liability, but predicts the advent of driverless cars will create a revolution in liability law.

Schellekens, M. (2015, August). Self-driving cars and the chilling effect of liability law. *Computer Law & Security Review, 31*(4), 506-517. https://doi.org/10.1016/j.clsr.2015.05.012

Abstract. Experimental self-driving cars are being tested on public roads, and will at some point be commercially sold or made otherwise available to the public. A self driving car [sic] and its digital control systems take over control tasks previously performed by the human driver. This places high demands on this control system which has to perform the highly complex task of driving the car through traffic. When this system does not perform its task adequately and damage ensues the failure of the control system may be used as a stepping stone to claim liability of the manufacturer of the car or the control system. Uncertainties about the application of (product) liability law may slow down the uptake of self-driving cars more than is warranted on the basis of technical progress. This article examines how the decision about the timing of a market introduction can be approached and how possible chilling effects of liability law can be redressed with an adequate system of obligatory insurance.

Summary. This source is relevant for this study because it examines the effects that self-driving vehicles will have on liability law, insurance, and the innovation of driverless vehicles.

The author notes that the Geneva Convention on Road Traffic (GCRT) and Vienna Convention for Road Traffic (VCRT) set the rules for road behaviors and require that all vehicles must have a driver, thus making the adaptation of the rules of the road to driverless vehicles difficult.

The author posits that driverless car manufacturers have no direct concern about how liability would affect a driver, but the relationship between driver and manufacturer will be relevant nonetheless. The author provides the example that case law has determined that manufacturers must take into account the fact that the user of the product will not always take precautions to prevent a peril. Also, the author notes that the public is not always entitled to expect that a product will always be absolutely safe. For example, if a vehicle had a shorter braking distance, then some accidents could be avoided, but it is unreasonable to state that a vehicle with an already safe braking distance is unsafe because it is not manufactured with the shortest braking distance possible, thus putting some of the responsibility for error on the driver. The author notes that the question of how much safety a person can expect from an autonomous vehicle cannot be currently answered, because the standard for safety is presently unknown.

The author posits that the standard for product liability is the safety a person is entitled to expect, and that driverless cars should at least aim to be as safe as non-automated vehicles. This, recommendation however raises the questions of how to define an average or good driver and how to determine that standard. The author predicts that driverless vehicle manufacturers will advertise the safety aspects of their driverless cars, which will then raise the public's expectation of safety when it comes to operating these vehicles.

The author asserts that auto insurance can provide part of the solution to reducing liability against a driverless vehicle manufacturer. Insurance could be used as it currently is to compensate drivers who are injured as a result of an accident. However, the author posits that

insurers will pursue the ability to seek recourse from the manufacturer in the event of a driverless vehicle accident, thus not eliminating liability against the manufacturers.

The author concludes the study by advancing the idea that maintaining independent insurance companies to compensate drivers in the event of an accident involving a driverless car would be the preferred liability solution as it would shield manufacturers from direct liability claims in these accidents. If manufacturers are uncertain about how they will be affected in terms of legal liability, the innovation of self-driving vehicles may slow. The author posits that insurance companies and driverless car manufacturers must agree on the question of liability in order to continue the innovation of these vehicles.

Category 3: Impact on Insurers' Profitability

Jiang, T., Petrovic, S., Ayyer, U., Tolani, A., & Husain, S. (2015, June). Self-driving cars: Disruptive or incremental. *Applied Innovation Review, 2015*(1), 3-22. Retrieved from http://cet.berkeley.edu/wp-content/uploads/Self-Driving-Cars.pdf

Abstract. Are self-driving cars in our near future? In what ways do Google's self-driving car project disrupt the auto industry? How are the auto manufacturers addressing this challenge? What suppliers will benefit from this technological revolution? Will the standards and regulations industries be ready? This paper aims to answer some of these questions and describe an overall state of the market for self-driving vehicles.

Summary. This source is relevant for this study because it explores the potential market share of driverless vehicles and how the automotive and insurance industries will be financially affected by the introduction of autonomous vehicles. The authors posit that by the year 2020, fully autonomous vehicles will be in production from manufacturers such as Mercedes-Benz,

Nissan, Volvo, BMW, and Audi, and that by the year 2035, 50% of the cars on the road will be autonomous.

The authors provide that the automobile insurance industry is currently a $200 billion industry, which will be transformed by declining profits with the advent of driverless cars. This study estimates that car accidents will decline by 90% as self-driving cars become widespread, and that manufacturers will sell policies to cover their own claims as product liability claims replace claims against insurance companies. The authors posit that as self-driving cars become popular, a "robo-taxi" market will emerge that will be a result of rental car companies, taxi services, and ride sharing industries merging, thus reducing the ownership of vehicles and affecting the auto insurance industry. The authors predict, however, that insurance companies will still be relevant so long as insurance is tied to the vehicle and not to the driver. Furthermore, when vehicles reach total automation (and the need for a driver is moot), liability laws will shift to affect auto manufacturers directly.

The authors conclude that auto insurance companies will ultimately be on the losing end of driverless car innovation. This prediction is attributed to the fact that auto insurance premiums will decrease due to a reduced number of accidents, and responsibility will shift from the driver to the vehicle, thus ushering in an era of product liability and self-insurance from the manufacturers directly.

Schroll, C. (2015). Splitting the bill: Creating a national car insurance fund to pay for accidents in autonomous vehicles. *Northwestern University Law Review, 109*(3), 803-833. Retrieved from http://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?article=1213&context=nulr

Abstract. While self-driving cars may seem like something that can exist only in a futuristic movie, the technology is developing rapidly, and many states already allow test runs of self-driving cars on state roads. Many car companies have announced that they will make self-driving cars available as early as 2020. However, several manufacturers of the selfdriving [sic] car technology predict that personal ownership of vehicles will be replaced by a car-sharing system, where companies own the self-driving cars and rent them to consumers who pay per use. With more widespread introduction of this technology comes many questions about how to assess liability for accidents involving self-driving cars, and how insurance should be structured to pay for those accidents. This note discusses the potential parties who could be held liable: drivers, car-sharing companies, and manufacturers. This Comment suggests the elimination of liability for any accidents involving self-driving cars, and recommends the creation of a National Insurance Fund to pay for all damages resulting from those accidents.

Summary. This source is relevant for this study because it introduces the idea of a centralized fund from which to pay for driverless car accidents and explores the impact this change will have on the future of the auto insurance industry. The author describes the current automobile insurance system as consisting of policies that are purchased per individual state requirements that include some level of liability coverage that pays for damages to someone else caused by the at fault party, first-party coverage, medical expense coverage, and uninsured motorist coverage. Some states, however, offer no-fault insurance where parties make claims under their own policy rather than seeking compensation under the responsible party's liability coverage. The author notes that some scholars have suggested that an entirely no-fault system would be adequate to handle the liability issues with autonomous vehicles. The author also examines how, under the current system, drivers are held liable for accidents, thus paying for

insurance premiums to cover them when damages are owed to another party. The author posits that in the case of autonomous vehicles, however, manufactures should bear the responsibility of paying the costs from any accidents their vehicles cause because the driver has no control over the vehicle.

The author suggests creating a federally run national car insurance fund which would pay claims for driverless car accidents. This program would be funded through taxes contributed by riders, car-sharing companies, and manufacturers of driverless cars. The author posits that the federally run program could raise insurance rates on the manufacturers based on the frequency with which their vehicles are involved in accidents, similar to how private insurance companies raise rates on higher risk drivers. In order to operate the fund, one option is for private insurance companies to run it based on the insurance experience those companies already possess. The author notes one drawback to the plan: costs will be higher by using private insurance companies, since they are for-profit companies. However, with the federal program as the only option available, prices would be lower for all parties paying taxes towards the fund. The author posits that the federal fund would not be beneficial for insurance companies, as there would no longer be risky or safe drivers to insure. Also, a federal fund for autonomous vehicle coverage would save hundreds of dollars per individual, would eliminate deductibles, and would eliminate the need for private insurance for autonomous vehicles.

The author does mention that there are barriers to creating such a fund, such as the public preference for private companies as opposed to further government intervention. Another potential barrier to creating this fund is the lobbyists on behalf of personal injury attorneys and the private automobile insurance companies who can use their considerable financial resources to block legislation creating such a fund. The author posits that the federal fund would pose

considerable losses for the insurance industry, but notes that the day-to-day handling of claims could be administered by the private insurers to prevent them from going out of business. The author concludes that the creation of a no-fault system paired with a national car insurance fund is at least one option, of many, that could help in distributing the costs of driverless car accidents fairly.

Conclusion

Driverless cars are in development by numerous automotive manufacturers and are projected to be a prevalent mode of transportation within the next decade (Shontell, 2016). General Motors, Ford, Toyota, BMW, Mercedes, Volkswagen, Audi, Volvo, and Honda are all developing self-driving cars (Fournier, 2016). The advent of driverless cars is expected to disrupt the automobile insurance industry as vehicles evolve from partially autonomous to fully autonomous (Swanson, 2014). As stated in *Autonomous Vehicle Technology: A Guide for Policymakers*, the authors posit that the ultimate goal in the use of driverless vehicles is to reach the fifth level of automation: a vehicle operating without a driver required (Anderson et al., 2014). With cars that remove driver error, the number of automobile accidents is predicted to be reduced by 90 percent, and the resulting impact to the automobile industry is expected to be widespread and substantial (Jiang et al., 2015).

This annotated bibliography utilizes scholarly and professional sources to provide background information on driverless vehicle technology and explore available options for determining legal liability in a driverless vehicle society. Additionally, sources are presented to outline the financial impact driverless cars will have on the automobile insurance industry.

Driverless Cars and Liability: Preparing for a New Paradigm

Although there are no fully autonomous vehicles on the road, and thus no data on liability costs have been analyzed, generally speaking it is more costly to pursue claims through product liability litigation than pursuing compensation from traditional automobile insurance companies for accidents (Anderson et al., 2014). Boeglin (2015) asserts that manufacturers should still be held accountable for software or other malfunctions in driverless cars that relate to the vehicle itself. In fact, the risk posed to the general public through glitches in autonomous technology has

already led to suits against manufacturers, such as litigation against Toyota for malfunctions in autonomous acceleration systems (Duffy & Hopkins, 2013). However, since many manufacturers will be needed to produce all of the components that compromise self-driving vehicles, it could prove difficult to determine which manufacturer should be responsible for which component. Some insurance experts have therefore suggested that private insurance companies could more efficiently resolve claims by working through a revised no-fault system, which is a system in place for drivers to bring claims against their own insurers rather than filing claims through the at-fault driver's insurance company (Eastman, 2016). Questions remain about how manufacturers and insurers will respond to adapting liability standards with the adoption of driverless cars, but Schellekens (2015) believes that harmonizing the relationships between these two entities will be necessary to resolve liability issues.

While some of the focus of liability is on the manufacturers of autonomous vehicles, other research focuses on the liability of the drivers of these vehicles in the event of an accident (Gurney, 2013; Herd, 2013; Preciado, 2014; Rapaczynski, 2016). In "Sue my Car not Me: Products Liability and Accidents Involving Autonomous Vehicles," Gurney (2013) notes that there is a spectrum of drivers ranging from disabled drivers to attentive drivers, and depending on the level of control the driver has over the autonomous vehicle, liability could be found against either the manufacturer or the driver. Greenblatt (2016) believes that current liability laws could translate easily to laws governing liability for accidents caused by driverless cars by finding the manufacturers of driverless vehicles to be as liable as an ordinary driver would be given the same conditions.

Herd (2013) suggests using air or maritime standards of liability (which find pilots of aircraft and boats liable if something goes wrong with their auto-pilot systems) as an option to

determine liability in driverless car accidents. Also, as Hevelke and Nida-Rumelin (2015) note, drivers assume the risk of danger when operating an automobile, which would not change just because the vehicle is autonomous; thus, a driver should be held liable for an autonomous vehicle accident. But where is the line drawn between a manufacturer's responsibility versus a driver's responsibility when there is an autonomous vehicle accident? Preciado (2014) suggests that creating a statute of repose may be an option to relieve manufacturers of responsibility if the owner/driver does not properly update the software in the driverless car in a timely fashion, which could have a direct impact on a malfunction. Rapaczynski (2016) proposed the idea that drivers can agree to release manufacturers from certain types of accidents when they are purchasing autonomous vehicles, thus eliminating questions of liability early.

Impact on Insurers' Profitability

As driverless cars become more integrated into society, Jiang, Petrovic, Ayyer, Tolani, and Husain (2015) predict a reduced need for vehicle ownership in lieu of using autonomous "robo-taxi" services. The reduced need for vehicle ownership is predicted to lead to reduced profits in what is currently a $200B automobile insurance industry, since the need for insurance companies will diminish based on a projected 90 percent reduction in traffic accidents when passengers migrate to using autonomous "robo-taxi" services (Jiang et al., 2015). One idea for evolving the insurance industry as adoption of autonomous vehicles becomes widespread is to create a national fund that all drivers could access in the event of an accidents; this move would, however, effectively render the automobile insurance industry moot, as its business would not be needed to carry out claims handling (Schroll, 2015).

Eastman (2016) notes that expanding no-fault automobile insurance laws across all U.S. states for autonomous vehicles would keep private insurance companies relevant. Some insurers

are already experimenting with alternative insurance products by charging premiums per mile driven for ride-sharing services, which could help in the evolution of insurance premiums and autonomous cars (Eastman, 2016). Although no-fault insurance is an option in keeping private insurance companies relevant in a driverless society, Schellekens (2015) posits that this approach would likely make automobile insurance premiums more expensive for drivers, which is counter-intuitive to current risk assessments because driverless cars are thought to be safer than traditional automobiles. There is still much to be determined pertaining to the harmonization of product liability, driverless cars, and the relevancy of the automobile insurance industry, and alternative methods of insuring vehicles should be examined during the driverless evolution (Eastman, 2016; Schellekens, 2015).

Recommendations for Further Research

The research presented in this annotated bibliography posits several ideas about how to solve the questions surrounding legal liability pertaining to autonomous vehicles, while also exploring what would appear to be a reduced need for the automobile insurance industry. More research should be done to examine how legal liability would apply for individual U.S. states. Questions that are currently unanswered include whether there should be a set of federal autonomous vehicle liability laws, or whether each state should adapt its own set of rules. As of 2015, only six states had enacted legal liability laws pertaining to driverless vehicles, with sixteen other states beginning legislation (Fournier, 2016). Additionally, more research should be done on what kind of insurance products for driverless cars can be offered so the automobile insurance industry can stay relevant when these vehicles become more prevalent. While the examination of the impact driverless cars will have in relation to liability laws and the profits of the auto insurance industry is in its relative infancy, the information presented in this annotated

bibliography can help provide context of what ideas are being shared amongst the scholars and professionals with interests in this matter.

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